

REMARKS

Claims 1-30 are pending in the application. Claims 1, 12, 15, 19, 23, 26 and 27 have been amended. No new matter has been introduced. Claims 23, 26 and 27 have been amended to correct some grammatical errors and to make the preambles in the claims consistent. These amendments to the claims do not narrow the scope of the claims, and were not made for reasons of patentability. Claim 15 has been amended to clarify that the birefringent material segment is translated across the longitudinal axis. This amendment was not made for reasons of patentability and is believed not to narrow the scope of the claim. New claims 29 and 30 have been added. No new matter has been introduced.

Drawing Objections

FIGs. 1-3 were objected to for not including a "Prior Art" label. Corrected drawings are enclosed.

Rejection under 35 U.S.C. § 103(a)

Claims 1, 2, 5-14, 17-21, 23, 24 27 and 28

Claims 1, 2, 5-14, 17-21, 23, 24 27 and 28 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Berger et al. (U.S. Patent Publication No. 2002/0164124 A1) (Berger) in view of Krol et al. (U.S. Patent No. 6,370,286) (Krol).

Berger teaches an apparatus for tuning and frequency locking a laser. The apparatus includes a wavelength locker (23) that includes a tuning reference element (71), a locking reference element (72) and a calculation device that receives signals from the two elements. A portion of light from the optical source (24) is directed to the tuning reference element and to the locking reference element. The tuning element (71) has an output power that varies monotonically with input frequency over the operating frequency for the wavelength locker (paragraph [0034]), and a suitable transmission curve for the tuning reference element 71 is shown in FIG. 3. The first derivative of the transmission function of the tuning element is preferably substantially constant and the rms value of the transmission, i.e. the measure of the linearity of the transmission function, is preferably better than 0.998 across the frequency range of

the wavelength locker. Berger teaches that a representative element suitable for use as a tuning reference element includes a dispersive phase retarder plus at least one polarizer.

Berger also teaches that the locking element (72), has an output power that is frequency dependent and preferably has a multi-peaked transmission spectrum that can be periodic or non-periodic (para. [0037]). Berger teaches that examples of elements that have a periodic spectrum include interferometers and metal film dielectric filters or reflectors. Suitable interferometers include Mach Zehnder interferometers in bulk optic and guided wave form, fiber Bragg interferometers, air gapped etalons and Fabry Perot etalons.

It is stated in the Office Action that Berger teaches the inventions of claims 1, 12, 23 and 27 in that the tuning reference element 71, optical detector (82) and calculation device (73) can be used to generate a tuning error signal to stabilize the frequency of the optical source (24). It is also stated that Berger does not specifically teach the use of a birefringent element as a phase retarder for use in the tuning reference element, but that it is well known to use a birefringent element as a phase retarder, such as is taught by Krol. It is also stated in the Office Action that where the claimed difference involves the substitution of interchangeable or replaceable equivalents, and the reason for the selection of one equivalent for another was not to solve an existent problem, such substitution is obvious.

Three criteria must be met to establish a *prima facie* case of obviousness. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference, or combination of references, must teach or suggest all the claim limitations. MPEP § 2142. Applicant respectfully traverses the rejection since the proposed combination of references fails to teach or suggest all the elements of the invention and it would not be obvious for one of ordinary skill in the art to modify the reference in the manner suggested to obtain the claimed invention.

It is important first to identify an important difference in Berger's device, the difference between a tuning element and a locking element. A tuning element, as taught by Berger, has a monotonically varying output as a function of light frequency, so that there is a unique value to the output from the tuning element for each value of frequency over the operating range. This allows the user to tune the laser to a specific frequency within the frequency range. A locking element, as taught by Berger, has a multi-peaked transmission spectrum, preferably a periodic

spectrum, and the user locks, or stabilizes, the output frequency of the laser to a peak of the locking element. Thus, tuning and stabilizing are different operations and have different requirements.

It is also important to note that, while Berger suggests that a dispersive phase retarder might be used in a tuning element, Berger makes no such suggestion for the locking element. Clearly, Berger was aware of the use of dispersive phase retarders, but considered such devices to be unsuitable for use as a locking element.

The invention of claim 1 is directed to a light frequency stabilization unit for stabilizing light within a frequency range. The unit includes, *inter alia*, a birefringent element, a polarizer that receives the phase retarded light from the birefringent element, and an optical detector that produces an output signal that is periodic over the frequency range. This is supported, for example, in FIGs. 5 and 6 of the present application. In addition, claims 12, 19, 23 and 27 include that the signal produced by the detector is periodic over the frequency range.

This is very different from the proposed combination of Berger and Krol. Berger only teaches a dispersive phase retarder for the tuning element, not the locking element. The present invention, on the other hand, is directed to the stabilization, or locking, of the frequency of light, not tuning of the light.

According to the Office Action, it is well known that the dispersive phase retarder, a possibility for Berger's tuning element, could be a birefringent element such as is taught by Krol. Applicants respectfully disagree. Krol's device does not produce a monotonically varying output, and would, therefore, be completely unsuitable for use in a tuning element. Furthermore, there is nothing Berger or Krol to teach or suggest the use of a birefringent element as a locking element.

Accordingly, the proposed combination of references does not teach or suggest all the elements of the invention and one of ordinary skill in the art would not be motivated to combine the references in the manner proposed, since Krol's device is unsuitable for use in Berger's tuning element. Therefore, claims 1, 12, 19, 23 and 27 are not obvious over the proposed combination of references, and are allowable thereover.

Dependent claims 2, 5-11, 13, 14, 17, 18, 20, 21, 24 and 28 depend from independent claims 1, 12, 19, 23 and 27, and further define the inventions of these claims. Accordingly, Dependent claims 2, 5-11, 13, 14, 17, 18, 20, 21, 24 and 28 are also allowable.

Regarding claims 8 and 21, Krol only suggests that the odd and even channels are output of phase by a multiple of π , not an odd integer multiple of $\pi/2$.

Claims 3, 15 and 26

Claims 3, 15 and 26 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Berger and Krol in view of Chen et al. (U.S. Patent No. 6,005,995) (Chen). It is stated that the proposed combination of Berger and Krol do not teach a birefringent element including a plurality of birefringent segments, but that Chen, in FIG. 9A, does teach a plurality of segments. It is further stated that it would have been obvious to combine the teachings of Chen with Berger and Krol because the device of Chen can be used for controlling ITU frequencies.

Applicants respectfully disagree with the Examiner's characterization of Chen. In FIG. 9A, Chen shows a fiber (97) terminating at a fiber ferrule (97A). Light from the fiber is collimated in a GRIN lens (91), passes through a Fabry Perot etalon (90), and is refocused by a second GRIN lens (92) into another fiber (98) terminated at a second fiber ferrule (98A).

None of Chen's elements are taught as being birefringent. The GRIN lenses are glass lenses with a gradient refractive index. Chen teaches that the etalon can be made out of different glass materials. For example, Chen suggests using low thermal expansion glasses such as Zerodur™ and ULE™ (col. 6. lines 32-40), or forming the etalon as a composite element, using two materials with opposite temperature coefficients. Example of fused silica and FK51 glass are given. It is important to note, however, that all the materials suggested by Chen are glass materials for a Fabry Perot etalon: the glasses are not birefringent and Chen does not teach or suggest using birefringent materials in a Fabry Perot etalon.

Accordingly, the proposed combination of references fails to teach or suggest all the elements of claims 3, 15 and 26.

Claims 4, 16 and 25

Claims 4, 16 and 25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Berger and Krol in view of Chang et al. (U.S. Patent No. 6,335,830 B1) (Chang). It is stated in the Office Action that the combination of Berger and Krol teaches all the elements of the claims except for a thermally compensated birefringent element. Chang teaches an interleaver based on a birefringent element (420) that is composed of crystals selected to provide

improved thermal stability of a range of operating temperatures a compared to a single birefringent crystal (col. 5, line 66 – col. 6, line 11).

Chang does not, however, correct the deficiencies of the combination of Berger and Krol discussed above with respect to the independent claims, as discussed above. In particular, Chang does not teach or suggest using a birefringent element in a frequency locking system. Accordingly, claims 4, 16 and 25 are allowable over the proposed combination of Berger, Krol and Chang.

Claim 22

Claim 22 is rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Berger and Krol in view of Ukaji et al. (U.S. Patent No. 6,804,468 B1) (Ukaji). It is stated in the Office Action that the combination of Berger and Krol teaches all the elements of the claims except for a transceiver. Ukaji teaches the use of optical transceivers (5, 6) (col. 1, lines 15-16).

Ukaji does not, however, correct the deficiencies of the combination of Berger and Krol discussed above with respect to the independent claims, as discussed above. In particular, Ukaji does not teach or suggest using a birefringent element in a frequency locking system. Accordingly, claims 4, 16 and 25 are allowable over the proposed combination of Berger, Krol and Ukaji.

New claims 29 and 30

New claims 35 and 36 have been added and depend from independent claims 14 and 27 respectively. Support for these claims is provided in FIG. 6 and its description in the specification. No new matter has been added.

Conclusion

In view of the amendments and reasons provided above, it is believed that all pending claims are in condition for allowance. Applicant respectfully requests favorable reconsideration and early allowance of all pending claims.


If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicant's attorney of record, Iain A. McIntyre at (612) 436-9610.

Respectfully submitted,

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IN THE DRAWINGS

The attached sheets of drawings include changes to FIGs. 1-3. These sheets, which include FIGS. 1-3, replace the original sheets containing FIGs. 1-3. Prior Art labels have been added and the labels "Fabry Perot Etalon Assembly" have been corrected to spelling errors. It is believed the provision of marked-up copies of the drawings is not necessary due to the simplicity of the changes. If marked-up copies are required, the Examiner is invited to contact the below-signed attorney.

Attachments: Replacement sheets for FIGs. 1-3